Discovery

Assessment of physico-chemical parameters in the estuarine water of Devgad mangrove swamps, Maharashtra coasts

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Citation
Nisha R Mugade, Jagdish B Sapkale. Assessment of physico-chemical parameters in the estuarine water of Devgad mangrove swamps, Maharashtra coasts. *Discovery*, 2017, 53(263), 587-593

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ABSTRACT
The present research work has attempted to analyse the physico-chemical parameters of estuarine water of Devgad mangrove swamps of coastal Maharashtra. Water samples were collected from mouth zone, middle zone and upstream zone of Devgad estuary for pre and post monsoon season. The present study reveals that, salinity is one of the most important factors which

strongly influence the abundance and distribution of the mangroves in estuarine environment. Higher salinity recorded during pre monsoon season due to higher evaporation rate during summer season. Influx of fresh water through heavy rainfall and large quantity of fresh water inflow is high during monsoon that affects on the salinity level and reduces the overall content of salinity in the mangrove swamps.

Keywords: Physico-chemical parameters, Turbidity, pH, Nitrate, Total Hardness, Alkalinity.

1. INTRODUCTION

Mangrove forests are ecosystem that has most productive and biologically important in the world. It provides important and unique products to the human beings, mostly who live in the coastal area. Mangrove is natural vegetation, which performs its defensive role for the protection of coastal environment. Increasing population, rapid growth of Industrial and Urban sectors are directly or indirectly influencing on the mangrove ecosystem (Sapkale, 2014; Mugade and Sapkale, 2014; 2017a; 2017b). Andrade et.al (2011) in their studies on Mangalore coast concluded that the estuaries and coastal waters are receiving huge quantity of pollution load from the major industries and factories which are located at the upstream part. The pollution load includes runoff of the sediment, waste from oil refineries, nutrients and pesticides, iron ore residues from the nearby iron are company and chemicals from the chemical factory from the point source. They have found that the concentrations of most of physico-chemical components were deviated highly.

In the studies of Soundarapandian, pH varied from 7.2 to 7.9. Minimum pH was recorded during month of February and maximum during month of May. Higher value of pH during summer was due to the uptake of CO_2 by photosynthesizing organisms. In January to March pH was low due to the influence of fresh water inflow and dilution of sea water, low temperature (Soundarapandian et. al, 2009). During monsoon season water has a low transparency level and shows high turbidity due to the presence of high amount of suspended sediment load from the fresh water influx and bottom sediment suspension (Arumugam and Kumar, 2014). Due to the heavy rainfall turbidity is higher in the month of June. Turbidity of surface and bottom varied in the range 1.1- 2.31 NTU (Sheela and Kumar, 2014). In the present study also similar situation was seen at the time of survey during October 2014. Water was turbid due to the fresh water influx from monsoon.

In the Pinchavaram mangroves, southeast coast of India nitrate varied from 0.35 to 40.7 mg/l and that was a result of use of fertilizers and biological activities (Ramanathan et al, 1999). In Thane and Ulhas creeks nitrate varied from 0.3 mg/l to 0.7 mg/l and higher value of nitrate was the result of disposal of domestic water into the estuaries (Nikam et. al, 2008). Mangrove in Akkulam-Veli Lake had different range of nitrate in water and it ranged from 1.47 to 4.26 mg/l (Navami and jaya, 2013). Mainly the variation of physico-chemical parameter is depends on monsoon rain. In the environment nitrate is present naturally and it is a product of ammonia oxidizes, this ammonia released by the decomposed organic material (Sagar et. al, 2015). In mangrove region of east Godavari district nitrate in surface water was 45.4mg/l and 47.9mg/l during pre and post monsoon. A higher value of Nitrate shows the discharge of agricultural runoff into the water sources (Kumari et al, 2015; Divya S Rajan and Nikhila Leemon, 2015).

Water quality parameters like total hardness, salinity, sodium are controlled by the sea water influx to the lake and water bodies (Navami and Jaya, 2013). Due to leaching from soils and high background concentration of water hardness concentration is higher in water. As per the WHO permissible limit suggested that the values between 150 and 300 mg/l means water is hard and more than 300 mg/l means the water is very hard (Sagar et. al, 2015). "Alkalinity is a chemical measurement of water's ability to neutralize acid. Alkalinity is also a measure of water buffering capacity or its ability to resist changes in pH upon the addition of acids or bases" (Sagar et al, 2015). "Total dissolved solids are the total amount of mobile charged ions, including minerals, salts or metal dissolved in a given volume of water in g/L". TDS is directly related to purity and quality of purification system. (Sagar et al, 2015). Total dissolved solids are presents due to the industrial waste, animal waste, agricultural waste etc., and also caused by evaporation and less rainfall (P. Soundarapandian et. al, 2009). Monsoonal influence was found on the Total amount of TDS which represents maximum flow of turbid water from upstream of the river (Das, et al, 1997).

According to Lim et. al, (2012) the increasing rate of soil pH results rising the discharge rate of plant nutrients and also increases the availability of other nutrients like potassium calcium and magnesium (Lim et al, 2012). Potassium was recorded maximum in December to March, and minimum in the month of June to November at the Bhatye estuary (Bhaware et. al, 2013). Potassium in the water of estuaries in Rajapur and Devgad tehsil was higher during pre monsoon season and lower during post monsoon season. In Devgad estuaries potassium was decreased from mouth to upstream.

2. MATERIALS AND METHODS

Soil and water samples were collected from all the estuaries. For the sample collection stratified sampling method was used. Therefore, all estuaries were divided into three zones i.e. Mouth zone, middle zone and upstream zone. Water samples were collected from middle flow of the estuary therefore 'M' sign used for coding. So there was only one sample taken from one zone. So, for one estuary three water samples were collected from mouth, middle and upstream zones and in whole area total 18 samples were collected. Water sample were collected in the 1 litre plastic bottle. For water sample 'M' symbol and then zone number was used for coding.

Water pH was measured by using pH meter and Electrical Conductivity (EC) and Total Dissolve Solids were measured using Conductivity/TDS Meter. Turbidity was measured by using Turbidity meter. Water characteristic of dissolved oxygen (DO) was estimated using Winkler's methods. Analysis of Alkalinity, hardness, calcium and magnesium, carbonates, bicarbonates, chloride, sodium and phosphorus were determined by titration method. Fluoride and Nitrate were estimated by using ultraviolet spectrophotometer by the method of SPADNS (Mayuri Prajapati et al. 2015).

3. PHYSICO-CHEMICAL ANALYSIS OF WATER SAMPLES

Physio-chemical parameters are influence on the diversity of species, pattern, breeding and metabolism activities. Salinity, temperature, pH, Dissolve oxygen these are the main factors in coastal ecosystem. These factors making favourable condition for the survival of species but poor quality of water and soil can affect on the activities of species (Mugade and Sapkale, 2017c).

Table 1 Physico-Chemical Analysis of Water Samples of Devgad Estuary (Post-Monsoon)

Test	Devgad Post-Monsoon (Oct-2014)		
	M-1	M-2	M-3
Turbidity (NTU)	1.24	0.81	0.82
pH	7.25	7.26	7.9
Nitrate (mg/l)	18.23	17.94	17.95
Total Hardness (mg/l)	5400	2600	440
Alkalinity (mg/lit)	320	240	100
Total Dissolved Solids (ppt)	9.87	8.21	3.10
Electrical Conductivity (ms)	19.74	16.42	6.20
Fluoride (mg/l)	4.86	4.92	4.98
DO (mg/l)	4.2	3.9	3.7
Magnesium (meq/l)	84	42.4	2.2
Calcium (meq/l)	16.8	7.4	0.4
Carbonate (meq/l)	0.6	0	0.6
Bicarbonate (meq/l)	5	4.4	4.2
Chloride (meq/l)	83.6	40.4	2
Sodium (Na) (meq/l)	352.1	165.2	4.13
Potassium (K) (meq/l)	69.75	34	6.5
Sodium Absorption Ratio (meq/l)	49.60	33.11	3.62

| Residual Sodium Carbonates (meq/l) | -95.2 | -45.4 | 2.2 |

Source: Field work during October 2014

Table 2 Physico-Chemical Analysis of Water Samples of Devgad Estuary (Pre-Monsoon)

Test	Devgad Pre-Monsoon (April-2015)		
	M-1	M-2	M-3
Turbidity (NTU)	2.9	2.82	2.98
pH	7.35	7.63	7.46
Nitrate (mg/l)	2.23	1.20	0.19
Total Hardness (mg/l)	3300	3220	3280
Alkalinity (mg/lit)	220	240	200
Total Dissolved Solids (ppt)	8.93	8.89	8.91
Electrical Conductivity (ms)	17.87	17.78	17.83
Fluoride (mg/l)	0.02	0.02	0.02
DO (mg/l)	3.7	3.2	3
Magnesium (meq/l)	260.6	254.8	209.2
Calcium (meq/l)	40.6	38.2	34.8
Carbonate (meq/l)	0.8	1	0.8
Bicarbonate (meq/l)	4.4	5	4.6
Chloride (meq/l)	136.5	141.1	127.7
Sodium (Na) (meq/l)	559.85	569.90	459.94
Potassium (K) (meq/l)	635	557.5	407.5
Sodium Absorption Ratio (meq/l)	45.62	47.08	41.64
Residual Sodium Carbonates (meq/l)	-296	-287	-238.6

Source: Field work during April 2015

Table no. 1 and 2 shows that, during post-monsoon pH values of Devgad estuary was varied from 7.25, 7.26 to 7.9 at mouth, middle and upstream zones. pH values at the mouth and middle zone were increased during pre-monsoon than post-monsoon i.e. 7.35 and 7.63 but at the upstream zone it was decreased up to 7.46. In case of Devgad estuary turbidity level of the water was lower during post-monsoon season (plate 1), and it was decreased towards upstream zone, turbidity was 1.24, 0.81 and 0.82 NTU at mouth, middle and upstream zones respectively. But during pre-monsoon turbidity level was higher at the mouth which was decreased at the middle and again little bit increased at the upstream zone. The values of the turbidity were 2.9, 2.82 and 2.98 NTU

at the mouth, middle and upstream zones respectively. In Devgad estuary from mouth to upstream zones during post-monsoon season nitrate value ranged from 18.23 mg/l, 17.94 mg/l and 17.95 mg/l. During pre-monsoon season nitrate level in the water was decreased towards upstream zone. At the mouth nitrate level was 2.23 mg/l, at the middle and upstream it was 1.19 mg/l and 0.17 mg/l. This variation causes due to the disposal of sewage water in the mangrove swamps.

Mixing of sea water from the tidal inlets and estuaries influenced on the total hardness of the water components. In the present study at middle and upstream zones during pre-monsoon the total hardness of water was 2600 and 440 which was lower than post-monsoon i.e. 3200 mg/lit and 3280 mg/lit. But at the mouth zone total hardness of water was decreased during pre-monsoon (3300 mg/lit) than post-monsoon (5400 mg/lit). In the mouth and upstream zones of Devgad estuary during post and pre-monsoon season alkalinity was 320,100 mg/lit and 220, 200 mg/lit respectively. At the mouth zone alkalinity during post and pre –monsoon remains same i.e. 240 mg/lit. TDS during post monsoon was 9.87 ppt, 8.82 ppt at the mouth and middle but at the upstream TDS was increased up to 3.10 ppt. During pre monsoon TDS was slightly increased towards upstream. It was ranged from 8.39 ppt to 8.91 ppt. In case of Devgad estuary electrical conductivity was 19.74 mS at mouth zone, 16.42 mS at the middle zone and highly decreased at the upstream zone i.e. 6.20 mS during post-monsoon season. At the mouth, middle and upstream zones electrical conductivity during pre-monsoon were 17.87, 17.78 and 17.83 mS respectively. Potassium in the water of estuaries in Devgad was higher during pre monsoon season and lower during post monsoon season. Dissolved Oxygen concentrations in all parts of the sampling sites were relatively higher during post monsoon season as compared to pre-monsoon season due to mixing of the sea water. In Devgad estuary magnesium content in water during post monsoon was lower as compared to pre monsoon season. During post season magnesium ranged from 4.4 meq/l to 168 meq/l and during pre monsoon it was 209.6 meq/l to 260.6 meq/l. Calcium content in water during post monsoon was lower as compared to pre monsoon season. During post season calcium ranged from 0.8 meq/l to 33.6 meq/l and during pre monsoon it was 34.8 meq/l to 40.6 meq/l. In the mangrove swamps the chloride was ranged from 127.7 to 141.1 meq/l during pre-monsoon season. In Devgad mangrove swamps the water samples indicates very low proportion of carbonates during both seasons. Sodium absorption ratio during post monsoon season was ranged between 3.62 to 49.60 meq/l, that range was changed upto 41.61 to 47.08 meq/l during next pre-monsoon season. Residual Sodium Carbonates (meq/l) in the water of Devgad estuary was -95.2 to 2.20 meq/l at the time of post monsoon season. During pre-monsoon season the same has varied between -296 to -238.6 meq/l.

Plate 1 Turbidity Meter

Source: Field work (Photograph by author)

Plate 2 Colour of the solution before and after titrations – Chloride detection
Source: Water sample analysis (Photograph by author)

4. CONCLUSION

The analysis of physico-chemical parameters in the study area reveals that there is a variation in physico-chemical characteristics of estuarine water in the Devgad mangrove swamps. The variation in the differentiate parameters and nutrients are highly responsible for the growth and reproduction of mangroves species. Physico-chemical characteristics of water would form a useful tool for further ecological evaluation and monitoring of these mangroves ecosystems.

REFERENCE

1. Andrade F, Aravinda HB, Puttaiah ET. Studies on Mangalore coastal water pollution and its sources. Indian Journal of Science and Technology. 2011 May 1;4(5):553-7.

2. Arumugam A, Kumar SP. Evaluation of Physico-Chemical Parameters And Nutrients In The Mangrove Ecosystem Of Manakudy Estuary, Southwest Coast Of India. International Journal of Latest Research in Science and Technology. 2014;3(6):205-209.

3. Bhaware B, Rodríguez MA, Kurhe A. Study of seasonal variations in physico-chemical parameters and nutrients in water of Bhatye estuary, Ratnagiri central, West coast of India. International Journal of Environmental Sciences. 2013;3(5):1671-1677.

4. Das S, De M, Ganguly D, Maiti T.K, Mukherjee A, Jana TK, De TK. Depth Integrated Microbial Community and Physico-Chemical Properties in Mangrove Soil of Sundarban, India. Advances in Microbiology. 2012;2:234-240.

5. Divya S Rajan, Nikhila Leemon. A study on the physico-chemical parameters of Thodupuzha River, Idukki district. Discovery, 2015, 33(146), 5-11

6. Ezekwe CI, Edoghotu MI. Water quality and environmental health indicators in the Andoni River estuary, Eastern Niger Delta of Nigeria. Environmental Earth Sciences. 2015 Oct 1;74(7):6123-36.

7. Kumari BV, Murthy YLN. An Investigative Study on Hydro Geochemistry of Waters in Coringa Mangrove Region of East Godavari District, International Journal for Innovative Research in Science & Technology. 2015;2(1):98-107.

8. Lim ZK, Genevieve NHP, Goh MM, Loh TYK. Investigating The Effect of Soil pH on The Germination of Avicennia alba Seedlings. Report. Nature Society (Singapore). 2012.

9. Mayuri Prajapati, Namrata Jariwala, Agnihotri PG. Assessment of groundwater quality with special emphasis to fluoride contamination in and around Mandvi Taluka, Surat, Gujarat, India. Discovery, 2015, 41(188), 102-108

10. Mugade NR, Sapkale JB. A Review of Mangrove Conservation Studies in Maharashtra, India. International Journal of Engineering and Technical Research (IJETR). 2014;2(11):338-41.

11. Mugade NR, Sapkale JB. Ethnoecological Study of Mangroves along the Estuaries of Rajapur and Devgad Tehsils, Coastal Maharashtra. International Journal of Oceans and Oceanography. 2017a;11(1):31-44.

12. Mugade NR, Sapkale JB. Status of Heavy Metals (Fe, Zn, Cu, Mn) in the Mangrove Sediments of Rajapur Estuary, Coastal Maharashtra. International Journal of Engineering Trends and Technology (IJETT). 2017c; 49(3): 173-176.

13. Mugade NR, Sapkale JB. Use of Mangrove Swamps for Agricultural and House Construction Activities: A Study of Devgad and Rajapur Tehsils of Coastal Maharashtra. Indian Journal of Science and Technology. 2017b; 10(23):1-10.

14. Navami SS, Jaya DS. Assessment of Pollution Stress on the Physio-Biochemical Characteristics of Mangrove Species in Akkulam-Veli Lake, South India. Global Journal of Environmental Research. 2013;7(2):26-33.

15. Nikam VS, Kumar A, Lalla K, Gupta K. Conservation of Wetlands and mangroves in Thane Creek and Ulhas River Estuary, India. Proceedings of Taal 2007: The 12th World Lake Conference. pp. 2007;1635-1642.

16. Ramanathan AL, Subramanian V, Ramesh R, Chidambaram S, James A. Environmental geochemistry of the Pichavaram mangrove ecosystem (tropical), southeast coast of India. Environmental Geology. 1999;37(3):223-233.

17. Sagar SS, Chavan RP, Patil CL, Shinde DN, Kekane SS. Physico-chemical parameters for testing of water- A review. International Journal of Chemical Studies. 2015;3(4):24-28.

18. Sapkale JB. Degradation of coastal sand dunes in Mithmumbari and Kunkeshwar of Devgad Coasts, Maharashtra. International Journal of Innovative Research in Science, Engineering and Technology. 2014;3(9):16097-03.

19. Sheela MS, Kumar SP. Metal mobilization and Physico-chemical parameters of water around mangrove forests in Manakudy Estuary, on the south west coast of India. International Journal of Environmental Sciences. 2014;4(5):633-640.

20. Soundarapandian P, Premkumar T, Dinakaran GK. Studies on the Physico-chemical Characteristics and Nutrients in the Uppanar Estuary of Cuddalore, South East Coast of India. Current Research Journal of Biological Sciences. 2009;1(3):102-105.